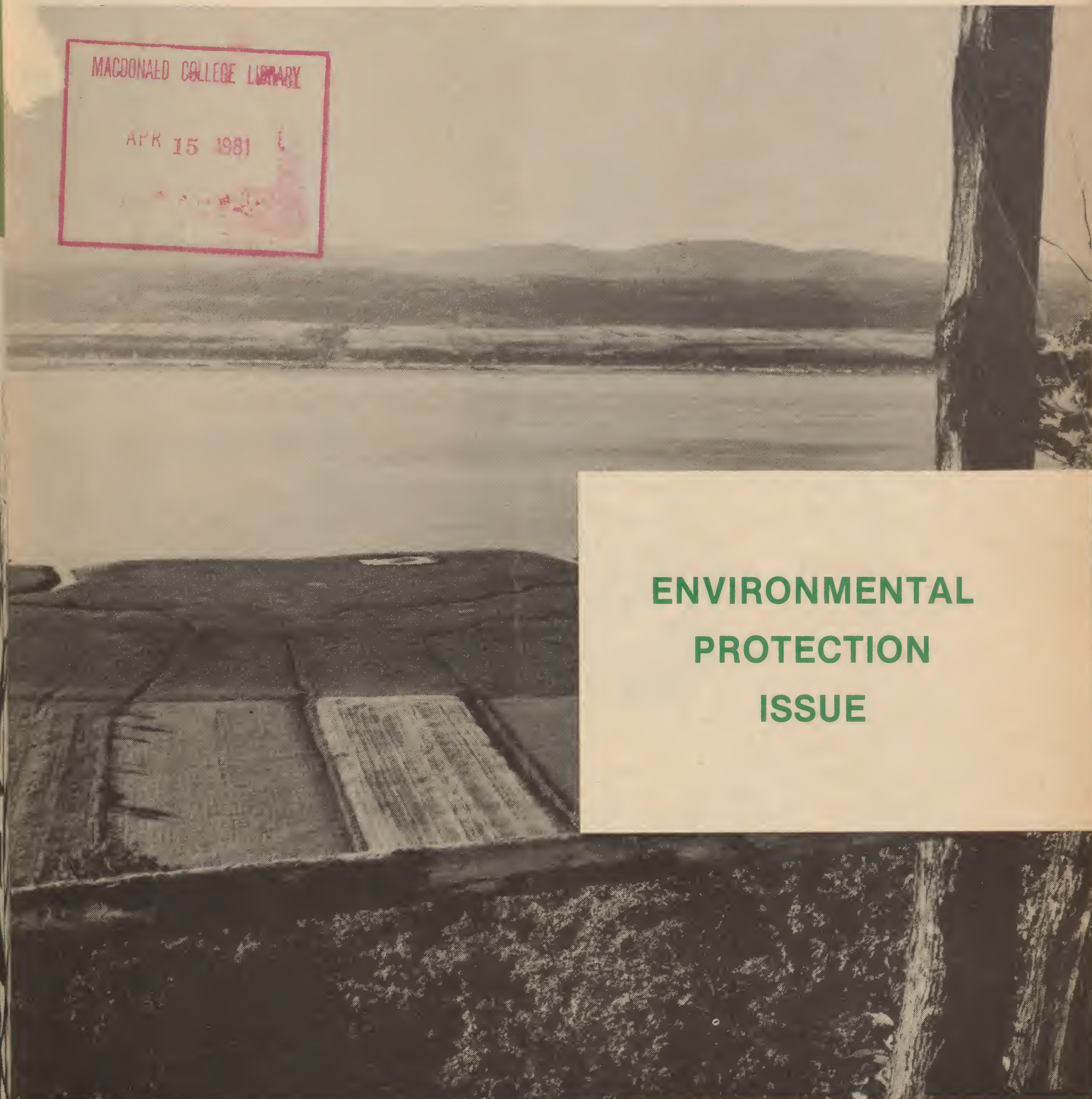
The Macdonald Journal

MARCH 1981



ENVIRONMENTAL
PROTECTION
ISSUE

Make It A Carlsberg.

The Macdonald Journal

MARCH 1981

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In This Issue

ırnal Jottings

ɔng the manuscripts on my desk this special issue on Ennmental Protection is a clipping Gazette column written a year o ago. The headline pulls no ches: "The dirtiest water in th America. Nowhere in Canada ɔr the U.S. — are sewage cons as primitive as Quebec's." A quotes from the column: "Each ıth as many as 50 municipalities ıis province receive telexes from Quebec Ministry of the Environıt with the same terse informa-: 'Your drinking water is coninated.' " "... the town's ·nham's) water source, the ıaska River, is so polluted by pig ıure and industrial waste micals that the water cannot sibly be purified." "Only about ıt per cent of Quebec's 6.5 on residents are served by age treatment plants. The other ɔer cent of the population dumps ewage straight into the province's streams, rivers, and lakes. (Ninety-five per cent of Montreal Island's sewage is dumped untreated into the St. Lawrence River.)"

Rather disquieting reading, but as Professor Guy Mehuys of the Department of Renewable Resources points out, "Columns such as these tell us all the problems, but rarely attempt to discuss the solutions." What is happening, should be happening, and will happen in combatting water pollution, in handling sewage sludge, swine waste, and pesticides are dealt with in this issue. I believe they offer a fair balance between the problems and the solutions or possible solutions in some areas of environmental concern in Quebec and elsewhere.

Professor Mehuys coordinated this special issue and I would like to thank him for his time, effort, and interest. He has been a most astute guest editor, and I believe enjoyed working with his colleagues: Professors A.C. Blackwood of the Department of Microbiology, P. Jutras of Agricultural Engineering, W. Marshall of Agricultural Chemistry and Physics, K. Stewart of Plant Science, and P. Warman of Renewable Resources. My thanks to them and especially to Pierre Vallée of the Quebec Ministry of the Environment for his editorial "Agriculture and the Environment" which starts off the issue so appropriately.

Not to detract in any way from The Gazette clipping, it is nonetheless true that news of doom and gloom appears to capture the largest headlines and the most amount of editorial space. It is to be hoped that an equal amount of space may justifiably be given to the positive advances in cleaning up our environment and maintaining its quality.

Hazel M. Clarke

Editorial

Agriculture and the Environment

Over the last 10 to 15 years many aspects of agriculture in Quebec have undergone quite an evolution. Confronted with increased production costs and reduced labour at an affordable price, farmers have had to strive for maximum efficiency on their farms.

As a result, farms have become more specialized. Now, one producer may specialize, for example, in cereals, another in corn, another in swine production, still others in dairy or beef cattle.

On animal production units, specialization has resulted in more manure being produced per farm. Furthermore, manure often is produced in liquid or semi-liquid form rather than solid. Unfortunately, all these changes in manure production have had a negative impact on surface and subsurface waters. Structures used to store manure on these farms are often inadequate. In many cases, storage capacity barely accommodates manure during the period when spreading is impossible. Weak structures (concrete blocks, concrete tanks with little steel reinforcement, etc.) have also been used with the result that large cracks often developed, sometimes completely rupturing the walls of the storage unit. Finally, several farmers have simply dug a pit in the ground to use as storage space or even have no storage facilities at all.

The specialization of animal production has also brought about many problems with manure spreading. The more specialized a farmer becomes, the less apt he is to produce all the animal feed he needs. We often see a farmer owning only the land on which his buildings stand. He finds himself in a situation where he has a lot of manure to spread and little or no land available. Spreading the manure on another farmer's land has become, in certain cases, more or less efficient. In some regions of Quebec, certain types of production (swine, for example) are so concentrated that all available surfaces under cultivation are still insufficient to adequately spread all the manure produced.

As it is costly for a farmer to transport manure to a less intensive region, the manure is often spread in excessive doses. Furthermore, to complicate matters, spreading comes at a time when fields are the least accessible, such as at seeding or in the autumn.

Nonetheless, we must not think that manure is the only source of pollution from agriculture. In other sectors, more recent developments such as increased mechanization, development of high-yielding varieties, the growing use of chemical fertilizers and of pesticides, etc., have resulted in an expanding agricultural economy. However, if we consider the environmental consequences that have begun to evolve in certain areas of Quebec, for example, where industrial crops are grown, we can ask ourselves if all these changes are, in fact, beneficial for the farmer. We have to think of the decrease in organic matter content in the soils of some regions. This has a direct influence on soil structure, its ability to retain plant nutrients, its erodibility, etc.

We must now admit that these agronomic problems do exist in some areas and that we are now faced with the environmental consequences of modern crop production. As a result, farmers lose large amounts of soil every year. Fertilizer elements, pesticides, etc., are washed away with the soil particles, thus damaging the quality of our rivers.

These then are the main problems caused by a development of agriculture that has disregarded the consequences it may have on the environment. It is therefore of the utmost importance that all those concerned (specialist and farmer alike) work together to minimize the effects of agricultural practices on the environment. It would only help agriculture if manure, chemical fertilizers, or pesticides were no longer found in our waterways, for it would mean then that these materials had been more efficiently utilized for growing more bountiful crops.

Pierre Vallée, Ing. Agr.
Ministère de l'Environnement, Québec.

The St. Lawrence River, pretty but polluted. See article on Page 3.

In keeping with our policy of freedom of expression, the opinions expressed are those of the author and not necessarily of the Journal.

Vater

Our Fragile Resource

Professor A.C. Blackwood
partment of Microbiology

are lucky in Quebec to live ere water is plentiful. Early man nd our rivers and many of our es rich in aquatic life, because it ved on the continual supply of rients from the large land area was drained. This phenomenon utrophication is natural and essary to maintain the nutrient les on which plant and animal depends. The native peoples and earliest settlers used the rivers transportation, as a food source, as a dumping ground for age and other effluents. They e not concerned with water logy, nor did they need to be.

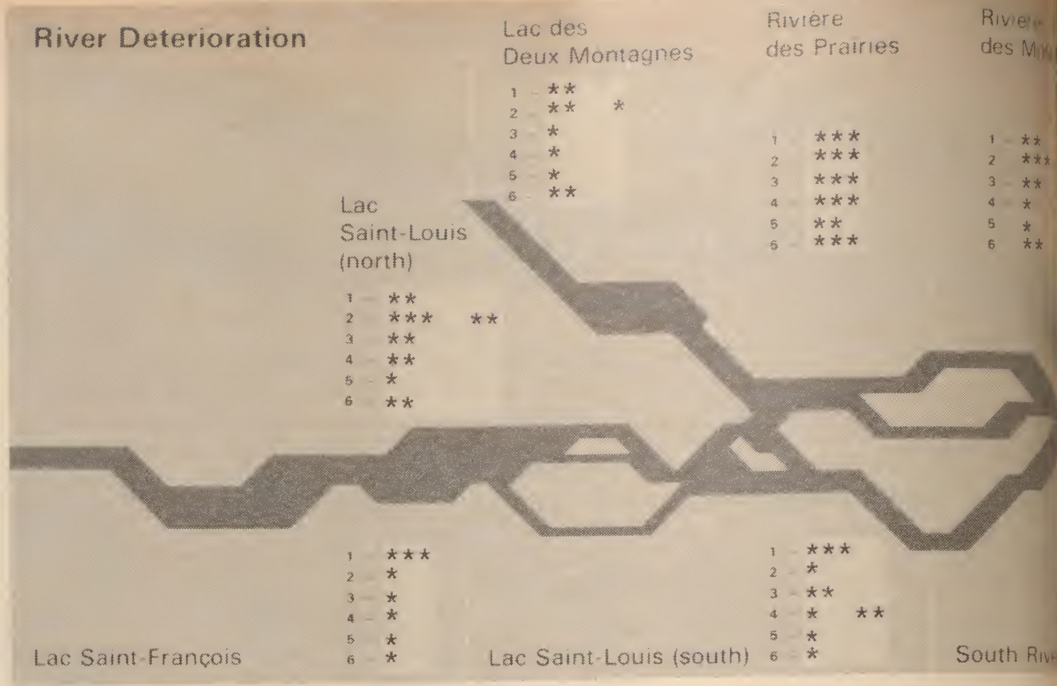
ce then, the rivers have changed in the area of land drained, in volume of water carried, in supng a means of transportation, as ource of water for household use for industry, and as a dumping und for sewage and other efnts. What has changed is that, in Quebec, about 3 million people live along the St. Lawrence River another 2 million occupy areas ned by its numerous tributaries. the time they reach us, the ers of the St. Lawrence and the awa Rivers have already been usby at least 12 million Canadians Americans living on the thern shores of the St. Lawrence the Great Lakes. These waters serve the high industrial contrations in southern Ontario, in States bordering Canada along water system, and the industry centrated in the Montreal region.

at is the problem with this elopment? The simple answer is we are dumping unbelievable ounts of pollutants into these s and rivers even though we know how to treat these effluents to make them much less noxious. Why don't we treat them? The general public, our industries, and our governments give this problem a low priority. Certainly, there are communities, there are industries, and there are government agencies that are very concerned about these problems, and they attempt to raise public consciousness to the seriousness of the problem. Let us consider the situation further.

During this century, nearly everyone in Quebec has obtained a water supply that is safe from a public health viewpoint. Water-borne diseases occur so rarely that an outbreak makes headlines in our daily news. The fact that we use our polluted rivers and lakes as a source for community water systems means that drinking water filtration plants do a remarkable job in removing pathogenic organisms under the watchful eye of the Quebec Water Resources Board. What we do not realize is that our senses can deceive and that the look of the body of water, the temperature, the taste and odour do not tell us if the water is potable (fit to drink), or safe to swim in, or good for fishing. Look at the picture on Page 2. It is a delightful scene of the St. Lawrence River showing its use for transportation and recreation. The waters look great, but we know from laboratory tests that the water must not be drunk, that in some areas fish and crustacea are contaminated, that pollution fouls the river and the shores, and that it is referred to by some knowledgeable people as "the largest open sewer in the world" — a somewhat exaggerated claim. If our senses deceive us, what kinds of analyses do we need? Analysis for coliforms as indicators of sewage pollution has over a long time proved a reliable test even though these bacteria found in the guts of animals, birds, and fish do not normally cause disease. Water from our major rivers and many of our lakes is not safe to drink untreated. Wells should be routinely tested as ground water can easily be contaminated. Not only are tests for sewage contamination required, but estimation of heavy metal ion concentrations and levels of various pesticides and herbicides must also be checked.

Total biodegradable pollution can be estimated by measuring the amount of oxygen needed to allow bacteria to utilize the pollutants. This B.O.D. test (Biochemical Oxygen Demand) is very widely used by industries to measure the amounts of pollutants discharged into our water system. Many industries are very concerned about actual or potential water pollution due to their activities; they know how to treat their effluent, and all that is needed is the determination and the provision of money to accomplish this. Obviously, no single plant can afford to spend the extra funds unless the whole industry co-operates, and thus government activities are important to coordinate, control, and perhaps fund the necessary changes.

In Quebec, forestry occupies an important position in industrial development and, because of its style of operation, is responsible for large scale pollution of lakes and rivers. Forests are sprayed with fertilizers and pesticides, logs are floated to the mills, water is used extensively in pulp and paper operations (one estimate is that the production of 1 ton of newsprint requires 250 tons of water), various chemicals are needed in the production process and all of these operations seriously



pollute. The industry has long-range plans, introduced by the government, to control most of this pollution. Is the time scale satisfactory?

Agricultural pollution is the most difficult problem to control, because a large number of operators is scattered over wide areas, each with his own requirements and solutions for field and animal management. Of all groups of producers, farmers are, by their very experience, those most aware of the value of good ecological practice. However, the economics of food production favour the large operator using intensive methods and the difficulties of good management are amplified. The most severe problems concerning water pollution are caused by land erosion and runoff from feedlots and from excess application of fertilizers. However, many smaller streams are polluted from runoff of untreated human and animal sewage, although we are all aware that properly installed septic tanks and lagoons would limit the problem.

What role do all these events pla the St. Lawrence River system? T stylized map of the St. Lawrence showing "River Deterioration" is based on a report of a Quebec-Federal Government survey in w many parameters associated wit the health of the river were assessed. Two conclusions are evi dent. First, we see that, while the rivers are already carrying a hea load of nutrients and toxic substances as they enter Lake St Francis and Lake of Two Mounta the St. Lawrence becomes more

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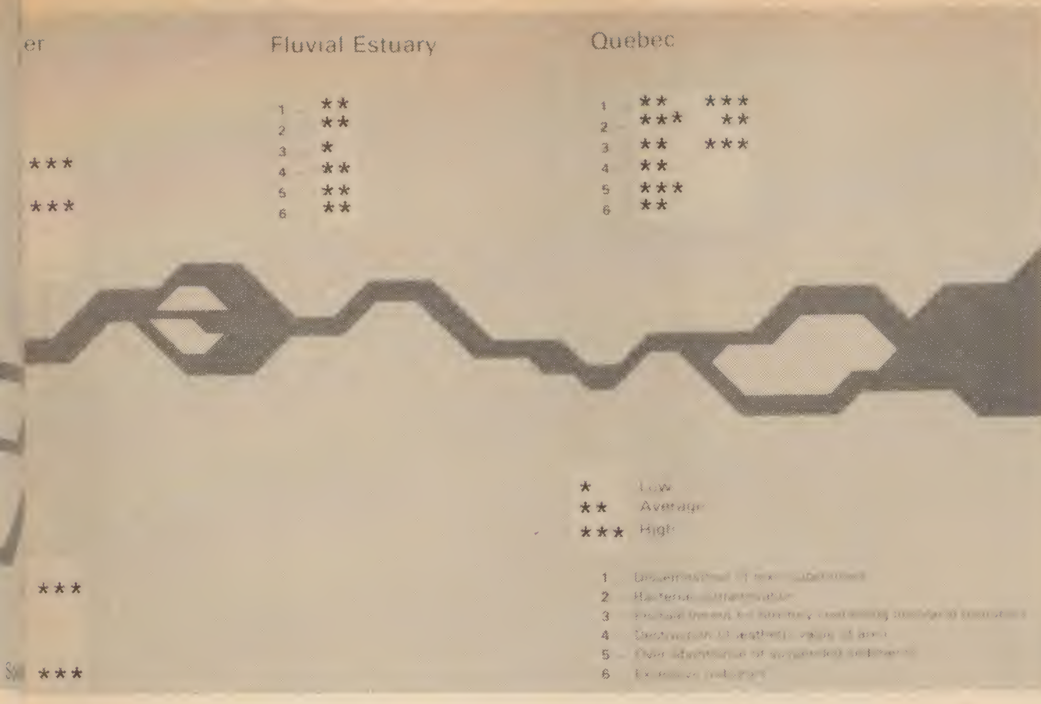
Land Application of Sewage Sludge

by Professors G. Mehuys and P.R. Warman
Department of Renewable Resources

In most municipalities in Quebec that have a sanitary sewer system, the collected effluent is merely discharged to the nearest stream, river, or lake without any form of treatment. Over the years, with continued growth in population sizes, vastly increased amounts of untreated wastewaters have been discharged. Serious pollution of our water bodies has resulted. Beaches have been permanently closed to swimming due to the high numbers of pathogen organisms found in the water. Both quantities and kinds of fish and other aquatic species have been reduced. The increased organic load in the water robs fish and other organisms of life-supporting dissolved oxygen that is used up instead by microorganisms to decompose the added organic materials. In many instances, downstream communities have discovered that their drinking wa supply was no longer safe, necessitating either a new sourc supply or large expenditures for ditional treatment at the existing facility.

Of course, the larger the municip ty, the greater are the amounts o sewage produced and the more



more polluted as it approaches Gulf. In the Montreal region, ut 144 million gallons of unted effluent is discharged into water system each day and, in ebec overall, only about five per t of our effluent is treated. One son the river system entering n Ontario is not excessively uted is that about 90 per cent of effluents are treated in that prov- ·.

vever, in spite of the tremendous ılt to the St. Lawrence that we continue to make every day, the second conclusion is that the river is ecologically active. In spite of the large amount of pollutants added in the Montreal region (see the North and South River corridors), the St. Lawrence has recovered to a certain extent by the time it spreads into Lake St. Peter (see Fluvial Estuary).

We have the opportunity to clean up our beautiful and useful river. It will recover if each one of us undertakes to do what is necessary to stop treating our water systems as a dumping ground. In our modern, rapidly developing age, can we afford to treat our sewage and other effluents as did our ancestors? Obviously, we cannot continue to discard our refuse with which our neighbours downstream have to live. We must make it a priority for ourselves, our community, our industry, our governments. We could be proud of our magnificient waterway — I hope we will be before too long.

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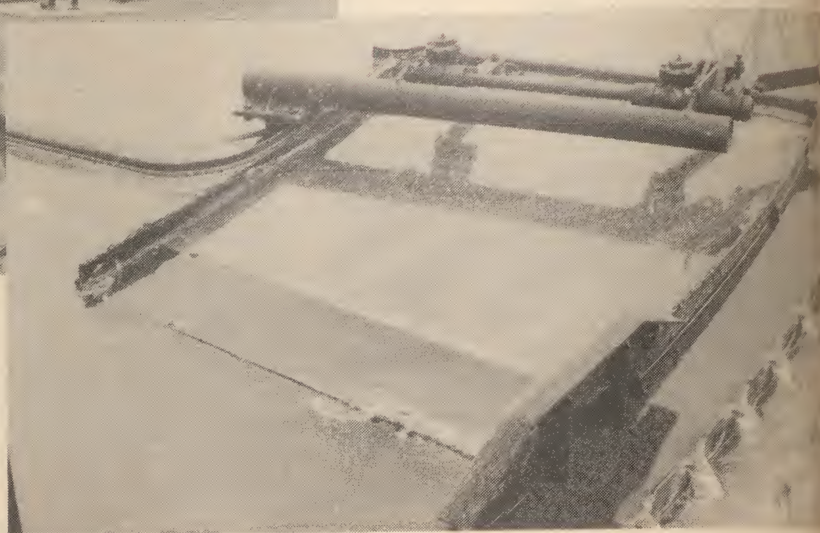
eterious are the effects on the eiving waters. Cleaner water, n, inevitably means treatment of wastewater. In this respect, the vince of Quebec is far behind er provinces and even further iind the United States or Europe. example, during the past 20 rs, no major sewage treatment ks have been carried out on the nd of Montreal, other than the struction of seven small treatnt plants mostly located in the st end of the island. Together, se plants treat no more than two cent of the total wastewater ume generated on the island. The t goes straight into Lake St. uis, Lake of Two Mountains, ière des Prairies, and the St. vrence River.

this may soon change, however. provincial government is firmly committed to cleaning up our natural water bodies. Billions of dollars will be spent on sewage treatment plants throughout the province over the next decade or so. The Montreal Urban Community has a plant planned for partial operation in 1983 and all municipal and industrial sewage generated on the island will be treated by 1988. Total cost for this plant alone with ancillary interceptor sewers is budgeted for $1.4 billion.
With treatment comes cleaner water, but also sludge — and lots of it. Sewage sludge is a broad term used to describe the solids, both organic and inorganic, removed from wastewater as it goes through a municipal treatment plant and is cleaned up for discharge. Two kinds of sludge are usually distinguished depending on the level of treatment performed at a particular plant.
Primary sludge contains the material that settles out during an initial or primary sedimentation process. Secondary treatment produces activated sludge. This consists mainly of concentrated bacterial cell masses resulting from the biological oxidation of the organic materials in the primary sludge. Both sludges are in liquid form with a concentration of 3 to 15 per cent solids. The solids consist of organic materials, such as paper, grease, oil, plastics, and bacterial cells and of inorganic elements, primarily nitrogen, phosphorus, potassium, calcium, and heavy metals. Quantities of these elements, especially the heavy metals, vary widely and depend in large measure on the amounts and types of commercial and industrial wastes that have found their way into municipal sewers.



Primary treatment of wastewaters is ac-complished in large sedimentation tank. Floating debris is skimmed from the sur (see insert). Here, treated water overflo and is discharged into a nearby river. It be collected for secondary treatment, w sludge is pumped from bottom of settling tank.

Further treatment is sometimes required depending on the use to which the sludge is to be put — dewatering for disposal or stabilization for utilization. Stabilization aims to reduce odour, pathogen content, and complex organic compounds and is accomplished by one of three methods. The two most common are biological digestion and chemical treatment. The third is composting, an age-old technology that has benefited from recent improvements (see following article).

The quantities of sludge produced can be enormous and increase with the amount of treatment provided at the plant. When in full operation, the proposed Montreal treatment plant will produce almost 800 metric tons of dewatered sludge per day, with only primary treatment implemented. So, the obvious question is what to do with it. Do we consider it a waste product and dispose of it, or can we recycle it more beneficially?

With currently available technologies, the disposal options are basically limited to two.

Sludge can be buried in a landfill. Particular attention must be paid to odour and pathogen control and to monitoring runoff and ground waters for possible contamination. If properly done, landfilling is an acceptable method of disposal. It requires, however, large tracts of land and trucking to distant sites is expensive.

The alternative to landfilling is incineration. Air pollution can be minimized in technically advanced facilities. However, installation and operating costs are high. Therefore, incineration remains a viable option only in large metropolitan areas. Because of the huge volumes of sludge produced in such plants and the escalating costs of hauling liquid or dried sludge to distant sites, incineration may prove to be less expensive in the long run. In fact, the Montreal Urban Community has chosen this very option for its new wastewater treatment plant. The left-over ash must still be disposed of in a landfill.

Recycling of city wastes on land is nothing new. Throughout the 19th and into the 20th century, farmers and scavengers ("night-soil men") collected human wastes from urban cesspools and privy vaults for use as fertilizer on a wide variety of crops. But progress meant sending city sewage to the nearest river, preferably downstream from the community, so that one city's wastes became the next city's drinking water.

Eventually though, cities began treating their wastewater prior to its discharge into the rivers. It was realized quite soon that the ensuing sewage sludge, because of its fertilizer and soil conditioning value, could be profitably recycled on cropland. Wastewater treatment plants and land spreading operations appeared first in Europe, principally in Germany, Holland, and Switzerland (see Macdonald Journal article on Land for Waste Management, May 1973). In the United States, the New Jersey Agricultu Experiment Station published a bulletin entitled "Agricultural Val of sewage sludge" as early as 1 Sewage sludge, once dried and p cessed, has even been successfu marketed as a fertilizer. Perhaps best known "proprietary" sludge that of Milwaukee, which is able sell, albeit at a loss, all it produce under the tradename "Milorganit Other large cities in the U.S. have begun similar programs in recent years; Chicago's "Nu-Earth" and Philadelphia's "Philorganic" are o fered free of charge to anyone w will take it away. In Ontario, liquid sludge is not only delivered to and spread on farmland free, but the farmer is also paid for every load accepts.

Since sewage sludge is regarded such a valuable resource, we wil next examine in some detail the merits of applying liquid sludge to land and its price in terms of en-vironmental impacts.

The primary advantage of spread sewage sludge on land or incor-porating it in a cropping program that sludge is a good source of organic matter and essential plan nutrients. Organic matter addition will improve soil chemical and physical properties. Sludge will in-crease the cation exchange capa

or nutrient holding capacity of the l. The waste will improve soil uctural stability and aggregation, rease the water-holding capacity the soil and make more water ailable to crops. Sludge incor- rated into the soil can reduce sur- ce runoff and erosion by improving ter infiltration into and movement ough the soil. Some of these ef- cts improve sandy soils, while hers improve the heavier clay ls. In clay soil, especially, the ad- d organic matter reduces com- ction, increases aeration in the oting environment, and improves erall workability of the soil. In san- soils, the primary merit of sludge orporation is improved water- lding capacity. Such soils may, refore, become less susceptible drought.

wage sludge contains important acro- and micronutrients. Although e nutrient concentrations in sludge e low — approximately in the me range as in animal manure — dge has been and can be applied rates which will supply all of the op's requirements for nitrogen and osphorus. Based on current fer- zer prices, the nutrient value of wage sludge ranges from $20 to 0 per metric ton on a dry-weight sis.

example of the total nutrient con- nt (on a dry weight basis) of a lean'' secondary sludge is given Table 1.

This sludge, at present de-watered and landfilled, is used by Dr. Warman in a number of different research projects at Macdonald. Its origin is the Vaudreuil Water Treatment facility which has few industrial inputs; consequently, it is relatively ''clean'' with respect to heavy metals. In fact, applications of this sewage sludge could improve the micronutrient content of the crop species grown on sludge-amended soil relative to the high analysis, commercial N-P-K fertilizers. Since animal diets are often deficient in trace elements such as zinc, copper, and selenium, sludge additions may improve the quality of feeds and forages used for animal consumption. Unfortunately, no one regularly analyzes sludge composition, and one could expect daily, weekly, or seasonal variation of sludge content. This non-uniformity of nutrient and metal contents would influence a person's desire to use sewage sludge in a cropping program, unless it could be analyzed immediately before spreading.

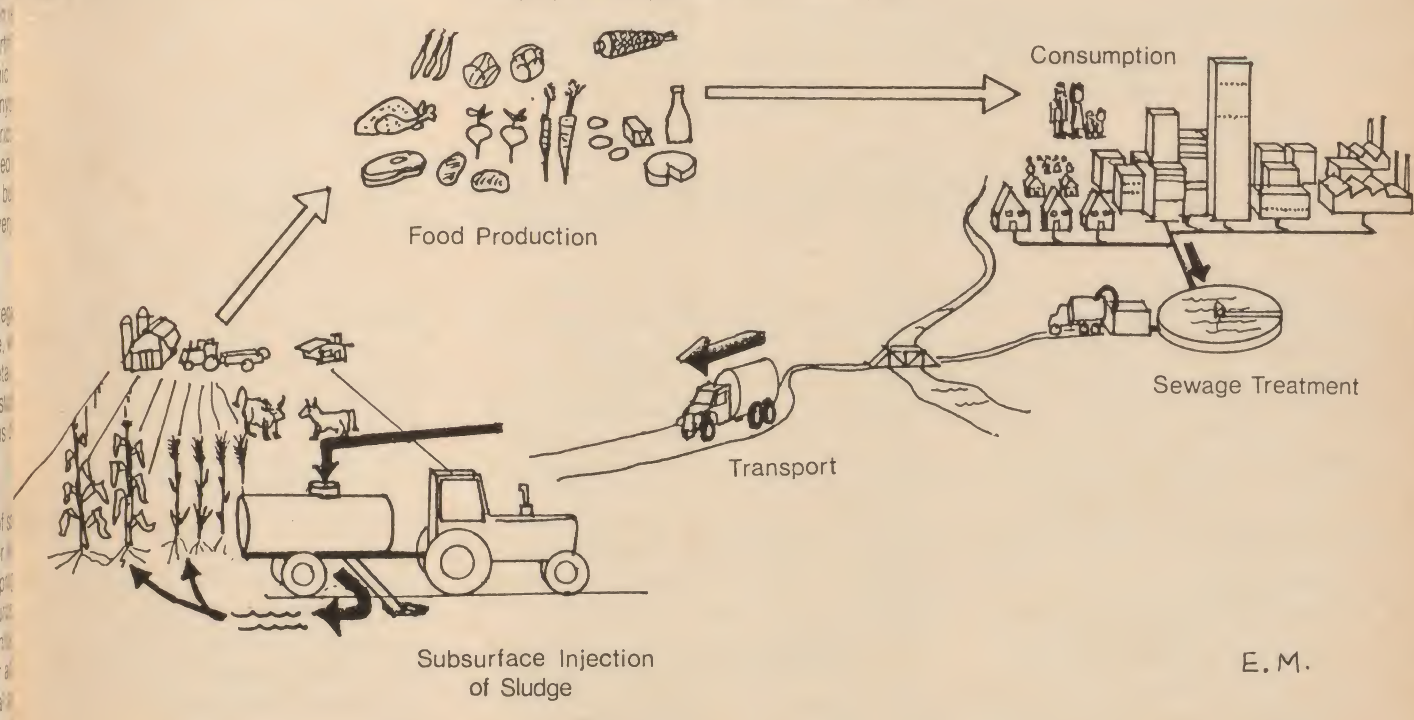
There are several problems and potential hazards associated with land application of sewage sludge. Because of the high amount of water in sludge (80-90 per cent), the cost of transportation, handling, and application may place sludge at an economic disadvantage relative to commercial fertilizers, especially if the distance of transport is great. Sewage sludge takes specialized containers and equipment for handling, transport, and spreading. A farmer would not normally own this type of equipment. However, as in certain areas of Ontario, sludge can be spread on farmland at no cost to the farmer by truckers on contract to the municipality. The major problem becomes the possibility of long-term soil contamination, toxicity to plants and major accumulation of toxic elements in the food supply.

There is a considerable amount of ongoing research aimed at determining the impact of heavy metals in sewage sludge on crop productivity, metal content of soils and plants, and consequences for livestock that

Table 1. **Macro- and micronutrient content of a secondary sewage sludge.**

Element	Content (%)	Element	Content (ppm)[3]
Nitrogen	4.0	Copper	220
Phosphorus	0.23[1]	Manganese	400
Potassium	0.15[2]	Zinc	430
Calcium	0.13	Cobalt	11
Magnesium	0.11	Lead	500
Iron	0.75	Cadmium	<5

[1]This analysis is much lower than others have reported.
[2]Much lower than found in animal manure.
[3]One part-per-million equals one ten-thousandth of a per cent.



ction is one way of recycling organic waste to the land.

consume these plants. Emphasis has been placed either on low rates of application of sludge with the objective of meeting the nitrogen fertilizer requirements of crops or on high sludge application rates in order to determine the maximum loading to a soil and the level at which plants cease production. In both cases, the origin of the sludge, the soil type, and the plant species under cultivation influence the results of the investigations.

It is generally agreed that the metals of greatest concern are zinc, copper, nickel, and cadmium. The first three are toxic to plants at high concentrations, while concern about cadmium is linked to animal and human health. It should be noted that zinc and copper are essential micronutrients for plants and animals; various species require them in different amounts.

Sewage sludge contains other metals as well, such as manganese, iron, chromium, arsenic, selenium, lead, and mercury in various concentrations. All these metals are not considered to represent a potentially serious hazard to plants or animals as long as good management is practiced at a sludge-treated site. Good management is related to the chemistry of the heavy metals in soils. At a soil pH near neutral (optimum of 6.5) and in well-aerated soils, little of the potentially hazardous metals in the soil are in solution or in an easily available form. Therefore, they are not readily absorbed by plants.

Uptake of sludge-borne metals also depends on plant type. Plant species and varieties differ in metal uptake and distribution within the plant varies also. In many crops, the seeds contain lower concentrations of metals than the vegetative tissues; therefore, if only the grain is harvested, the potential hazard of metals is reduced. Sludge sprayed on the foliage of pastures may result in metal-related animal health problems if the forage is ingested by grazing animals in sufficient quantities. Generally, grain crops present a lesser heavy metal hazard to the food supply than do forages, pastures, and leafy vegetables.

The other disadvantages with sewage sludge application involve public acceptance, odours, pathogens, parasites, and contamination of surface or ground waters. Sewage wastewaters and sludges contain human pathogens, many of which are destroyed during secondary sewage treatment. Pathogens can be reduced further in tertiary treatment by pasturization, composting, heat drying, and lime stabilization.

Soil moisture, pH, and temperature determine the survival of bacteria, viruses, and parasites in soils. Some organisms survive long enough to move into ground water with percolating soil water or reach streams in runoff. Movement of pathogens and also of salts, organic matter and nutrients, through soils is dependent on soil chemical and physical properties as well as on loading rates of the waste. Excessive loading rates as well as poor timing and placement of wastes can result in serious contamination of drinking water.

In conclusion, the use of sewage sludge on productive and marginal land has both merits and problems. Our research has shown that timothy yields are as good with sewage sludge as with commercial fertilizer, and plant nutrient content may even be better with sludge. On marginal land, sewage sludge amended hybrid poplar and regeneration forest sites respond with as good a growth as with chemical fertilizer additions. Hopefully, as more sludge is produced, it will become available to farmers and gardeners who could better use it as part of a cropping system than the current costly practice of landfilling or incineration.

Composting Sewage Sludge

by Professor K. A. Stewart
Department of Plant Science

Wastewater treatment plants regularly and successfully separate sewage into clean water and sludge. The sludge component must be disposed of in a fashion which will conform to the environmental standards of the country and will not offend the sensibilities of its citizens. The methods currently employed for sludge disposal often fail to satisfy the latter criteria and are becoming prohibitively expensive (Sanderson, 1980).

Recently, composting has been suggested as a suitable alternate method of sludge utilization. Composting has a number of advantages over the other systems. It is a low energy system as it generates heat through microbial decomposition. This heat can effectively destroy most pathogens. The material arising from the composting process is soil-like, odour-free and can be stored and handled using conventional machinery. A method of composting sewage sludge currently used in the United States is the Beltsville aerated-pile method developed by the United States Environmental Protection Agency in combination with the United States Department of Agriculture.

Composting the sludge

The Beltsville process of composting is outlined below. The sludge is mixed with a bulking agent in a ratio of 1:2 by volume in order to aerate the material. Bulking agents can include leaves, bark, sawdust, and woodchips. The resultant mixture is left for a period of approximately days (Figure 1), during which the

ganic material present will be
ecomposed through the action of
icrobes. The temperature
enerated during the decomposition
eriod reaches 60°C and can effec-
vely kill pathogens present in the
mpost. In order for effective
robic activity to occur, the pile
ust be aerated and this is ac-
mplished by the rapid circulation
air through a perforated pipe
cated below the pile (Figure 2).
dours are removed through water
aps and filter piles (Figure 2).

ter the composting period, two
ternative methods of processing
ist. The first (Option A, Figure 1) is
rried on out-of-doors, when the
mate permits. The pile is left ex-
osed to the elements to dry out un-
it reaches approximately 40-45
r cent of the original moisture
ntent. Then, the compost and
lking material are separated by
reening the bulking material out
d recycling it. The compost is
en cured (continued decomposi-
n), stored, packaged, and sold.
e second method (Option B,
gure 1) is generally followed when
e weather conditions will not
cilitate drying. Consequently, the
mpost is left for a period of fur-
er decomposition prior to drying
doors.

ses of the compost

egardless of the method of pro-
ssing, the resultant compost has a
mber of uses in agriculture. Some
ethods of compost utilization are
en in Table 1. Compost can be
ed to enhance soil productivity.
hen added to sandy soils, it in-
eases the water holding capacity
the soil. In combination with clay
clay loam soils, it improves soil
ucture and increases permeability
both air and water, thereby reduc-
the amount of water runoff.

e compost is, however, low in
acro-nutrients (N.P.K.), and it must
combined with an inorganic fer-
zer in order to supply the plant's
quirements.

mposts are particularly useful in
eenhouses and nurseries where
ey can be used in combination
h other materials (bark) as a
bstitute for peat moss (Nelson,
72). Plane tree maple seedlings
own using a composted sewage

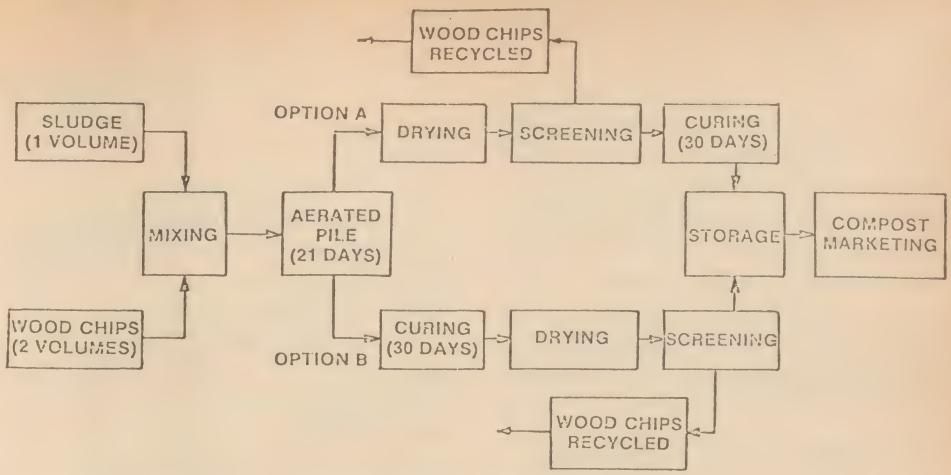


Figure 1. Flow diagram for composting. (Willson *et al.*, 1980).

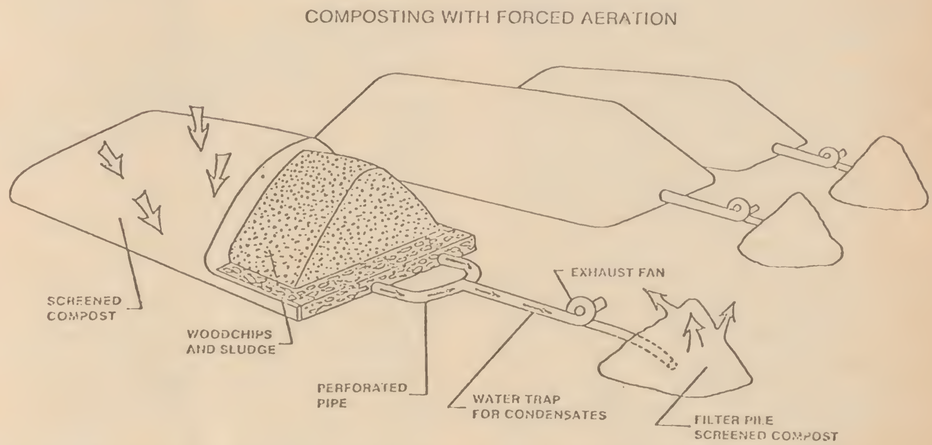


Figure 2. Schematic diagram of an aerated pile, showing location of aeration pipe. The piping under the pile is perforated for air distribution (Willson *et al.*, 1980).

Table 1. **Various uses and application rates of sewage sludge compost to achieve fertilizer benefits and soil improvement (Willson *et al.*, 1980)**

Use	Compost per 100 m²[1]	Remarks
	kg	
Vegetable crops:[2] Establishment	500-1,500	Rototill into surface 1-2 weeks before planting or in previous fall. Do not exceed recommended crop nitrogen rate.
Maintenance	500	Rate is for years after initial garden establishment. Rototill into surface 1-2 weeks before planting or in previous fall.
Nursery crops and ornamentals (shrubs and trees): Establishment	1,000-3,500	Incorporate with top 15-20 cm of soil. Do not use where acid-soil plants (azalea, rhododendron, etc.) are to be grown.
Maintenance	100-250	Broadcast uniformly on surface soil. Can be worked into soil or used as a mulch.
Potting mixes	Equal ratio of material[3]	Thoroughly water and drain mixes several times before planting to prevent salt injury to plants.
Mulch	150-350	Broadcast screened or unscreened compost uniformly on surface after seeding; unscreened is more effective.

1 750 kg per 100 m^2 is equal to 1.5 cm of compost per 100 m^2 or 75 wet tons per ha based on 40% moisture content and 1.5 cm screened material.

2 See the section on problems related to compost use prior to applying compost on vegetable crops.

3 Effective potting mixes have been prepared using equal volumes of sludge compost + peat moss + vermiculite, compost + peat + sand, or compost + infertile loamy subsoil. After several months' growth, supplemental nitrogen fertilizer may be required.

media were of superior quality to seedlings grown in unamended media (Lepp and Eardley, 1978).

Compost can also be used as a mulch material. It conserves water, reduces weed growth and maintains soil temperature. It is particularly useful in reducing soil erosion and therefore could be used along highways (Scarsbrook *et al.*, 1970).

However, there are some complications which can result from the use of sewage sludge compost.

Constraints on use of compost

A number of horticultural species — woody ornamentals, foliage and bedding plants — have exhibited chlorosis when planted in immature compost (less than four months old). The chlorosis has been attributed to a rapid decomposition of the available macro-nutrients and may be alleviated by the frequent application of fertilizer (Sanderson, 1971; Gagne and Sanderson, 1973; De Vleeschauwer *et al.*, 1979).

High levels of toxic elements, particularly lead, mercury, and cadmium, have been found in compost originating from heavy industry sewage which had been given minimal pre-treatment prior to composting. These elements accumulate in the leafy tissues of the plant and thus may enter the food chain. Of these, cadmium is the most dangerous and it is found in a wide range of crops. Mercury, although not normally a problem, may become so in mushroom production as the mushroom concentrates this element in the fruiting bodies (Willson *et al.*, 1980). Aside from building up toxic levels in the crops, the elements act to stunt the plant by inhibiting photosynthesis (Bazzaz, 1974). Compost enriched with nickel, zinc, and copper caused a reduction of growth and development of chrysanthemums, Easter lilies, and snapdragons (Gagne and Sanderson, 1975). These effects are particularly damaging when the compost is applied to acidic soils, especially those with a pH of 5.5 or less (Chaney, 1974). In order to reduce the risk of heavy metal enrichment in the composts, pre-treatment of industrial wastes must be practised and, if possible, these types of wastes should be disposed of in another way, leaving less dangerous material for decomposition.

The possible presence of pathogens and unpleasant odours may cause reluctance, both esthetic and environmental, to the use of compost by the horticultural industry. Most pathogens present in the sludge will be destroyed by the heat generated during the composting process. Only the salmonella organism can regrow in the finished compost. However, the growth is extremely limited and should not cause problems to human health.

If the Beltsville method of composting is employed, there will be no odour and the resulting compost will resemble a loamy soil and should not offend the user. The limitations of the composted material are minor compared to the advantages inherent in this method of sludge utilization. The increasing need for sewage treatment will ensure that composted sludge enters agriculture in a number of useful ways.

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by Professor Pierre J. Jutras
Department of Agricultural Engineering

The increasing industrialization of agriculture has meant the concentration of large numbers of ani- in single production units and the consequent creation of extreme complex pollution problems, wh- have led in some cases to the e- forced closure of existing enterprises. After much discussion, i- now commonly accepted that the problem of disposal of animal wastes must be solved by the agricultural industry itself, keep- mind that, although they are referred to as "wastes", they also present intriguing possibilities as a resource.

It is only recently that Quebec ha- seen intensive swine populations grow to such proportions in certa- parts of the province as to beco- a nuisance, both from a point of view of odour, as well as of wate- pollution. Local authorities are a- loss to come up with practical so- tions, and research activities in - field have not been coordinated o- even encouraged.

Where, then, can we look for answers? Perhaps it might be interesting to look at what more experienced countries are doing to alleviate the problem. A few years ago, a seminar on animal wastes was held in Bratislava, Czechoslovakia. It was organized jointly by the World Health Orga- tion and the government of Czechoslovakia, in cooperation w- the United Nations Development Program. Papers were presented leading authorities from around th- world on animal waste managem- This article will concentrate on w- they had to say about the problem of handling liquid manure in place of high intensity livestock operations.

In Romania, municipal-type wastewater treatment is applied t- liquid manure from large pig feedlots. Primary treatment is accomplished in horizontal settling tanks. Secondary treatment cons- of activated sludge basins with mechanical systems of aeration, o- oxidation ponds, followed by final

vine Waste 'anagement Systems Prevent Pollution

ng tanks and chlorination
e stream discharge. The sludge the primary settling tanks is de-red on drying beds or stabilized echanical sludge aerators.

ncourage the use of feedlot es on cropland, **manure banks** been organized in The erlands to subsidize the sportation of liquid manure to land over long distances, thus ulating its use on arable land belonging to the feedlot owners. e manure banks also advise ers on the correct application of iquid manure. The subsidy is n to the farmer who uses the li- manure when the hauling ance is more than 8 km. In 1975, 175,000 m³ were transported in province alone. Containers of 0 m³ (30-40 tonnes) are used for ient transport. Since these can- go on the receiving fields at all s, in-ground storage pits are on the arable farm. Subsidies also available for the construc- of these pits. In cases where pits are located in soils with high neability, films are used for lin- to prevent ground water pollu- The cost of these pits is in the nity of $5/m³.

In the German Democratic Republic (East Germany), research and development on problems of animal waste disposal proceed from the objective of closely linking the introduction of modern, industrial-type production methods into agriculture with the improvement of the working and living conditions of the working people. At the same time, it is of prime importance to raise soil fertility and to adapt the recreational value of the countryside to increasing demand. Specialists in agriculture, engineering, veterinary medicine, and others cooperate in a highly complex way to solve the tasks involved in the effective disposal of animal wastes.

In Hungary, a system of fines was promulgated for polluters of natural waters. This has brought about significant success in preserving the quality of water. Guidelines exist for the resolution of conflict between the public's demand for good, inexpensive pork and good, unpolluted water. If local and economic constraints do not permit utilization or land disposal of liquid manure, two alternatives may be followed: either manure is purified to a degree prescribed for municipal and industrial wastes before discharge in surface water or no animal feedlot with a hydraulic waste flushing system is permitted to operate in such localities.

The construction and operation of waste disposal and utilization systems is the responsibility of the enterprise but the government grants financial and technical aid to the enterprise.

The Hungarians have developed a biochemical treatment plant that is also marketed in other countries, such as Poland. In this system, the swine wastewaters are put through vibrating screens and then into a pre-aeration chamber which also serves as an equalizing surge tank with a detention time of 16 hours. Sixty-four per cent of the COD (Chemical Oxygen Demand) is removed from an influent with an initial COD of 10,000 to 20,000 mg/litre. After this primary settling, additional removal of solids is accomplished through coagulation with alum (aluminum sulphate), added at the rate of 1000 mg/litre. Further settling takes place, following which 85 per cent of the COD is removed. Then an activated sludge treatment which lasts about 14 hours is accomplished in aeration basins. After a final clarification and denitrification in anaerobic packed columns, 96 per cent of the COD is removed. The last step is chlorination of the effluent, if required by local authorities, leaving an effluent that is discharged into a body of water.

Sludges from sedimentation tanks are thickened and then placed on drying beds or centrifuged. The BOD (Biochemical Oxygen Demand) removal efficiency of the above treatment, called "Vidus", can be as high as 98 per cent, reducing the BOD from 8,600 to 200 mg/litre. COD is reduced from 15,000 to 450 mg/litre for a COD removal efficiency of 96 per cent. Even then, the effluent does not meet the Hungarian standards for all bio-engineering parameters, as shown in Table 1.

Treatment of wastewater requires high capital investments as compared to tank wagon transport (see Table 2).

le 1. **Effluent qualities obtainable with various treatment hnologies.**

nology	COD	BOD_5	Suspended solids	Total N	Total P	Total salts
	(mg/litre)					
erobic lagoon	2000-6000	1000-3000	100-200	400-600	20-50	1000
ation ditch*	800-1500	100- 200	100-200	400-600	20-50	1000
-activated sludge	300- 600	50- 100	20- 30	300-500	6- 8	800-1200
-activated sludge nd denitrification	350- 600	50- 70	20- 30	200-300	6- 8	800
ent standards	75	—	1000	40**	4***	1000

stimated from preliminary tests.
Free NH_4value; for lakes, 20 mg/litre NO_3.
PO_4 value.

le 2. **Relative capital and operating costs of pig feedlot wastewater atment and disposal systems in Hungary.**

hnology	Relative capita cost per pig capacity	Relative operating costs	
		Per pig/year	Per m³ of wastewater
k wagon transport	1•0	1•0	1•0
ation	2•2	0•5	0•8
chemical treatment f liquid	4•3	1•3	1•6
dge treatment of solids	2•5	1•0	1•1

: Relative cost of 1 0 represents $15/pig capacity for capital costs and $8/pig/year or $1.50/m³ for operating costs.

Increasing the size of the operation may reduce production costs per unit of animal capacity, but waste management problems increase. Hungarians have estimated that in their country the best size of swine operation is 8,000 to 10,000 pigs per farm, with the uppermost limit being 30,000.

Large animal feedlots of up to 100,000 pigs are now operational in Bulgaria. Biological treatment of wastewaters is required and removes 95 to 99 per cent of the BOD, whenever discharging of effluent to rivers with low flows takes place. Experience has shown there, as it has in Hungary and other countries, that for swine feedlots with 100,000 pigs, the capital costs for proper wastewater treatment are excessive, making such large feedlots economically unfeasible.

If we, in Quebec, wish to develop the Dutch idea of manure banks and transportation of liquid manure from the production area to cropland over long distances, storage structures will have to be devised and built on the arable farm. Above-ground tanks are less expensive to build than below-ground concrete tanks. Already, many have been built, but not enough, as was pointed out by a recent survey of the Yamaska River region by Macdonald Agricultural Engineers. Government subsidies are not now available to assist farmers in the construction of these above-ground structures. Research is being carried out at Macdonald to investigate the possibility of using earthen pits without polluting the ground water. If the results of these experiments are promising and the Ministry of the Environment looks favourably upon the idea, it would reduce the cost of liquid manure storage to an acceptable level.

Pilot-scale anaerobic lagoons of this type were constructed in Nova Scotia by engineers of the Nova Scotia Technical College in Halifax. Five representative Nova Scotian soils were selected for the study: sand, loamy sand, loam, silt loam and clay. The study was carried out from September 1976 to April 1977. The soils were well-compacted before the tests began. Generally, there was a sharp reduction of infiltration rates in all soils within the first few weeks and a gradual reduction thereafter, down to 0.045 cm/day, showing little differences among infiltration rates for different soil types after the sealing reached a stable state.

The soil lining anaerobic lagoons is believed to seal by a combination of physical, chemical, and biological processes. Some think that final sealing is by excretions from anaerobic microorganisms. It is interesting to note that the soil pores do not seal only at the soil-manure interface, but that clogging actually penetrates into the soil lining.

The tests being carried out by Macdonald Graduate Student Suzelle Barrington, under the supervision of the writer, are in various types of uncompacted soil and results from these tests should be available in the spring of 1982.

Conclusion

Based on current technology, it appears that there are three possibilities of solving the swine manure problem emanating from large-scale production farms which do not encompass enough land for spreading in acceptable doses:

1. Develop a transportation system to take the manure from the production farm to areas which can utilize the manure for land spreading. This process, along with the storage of the manure, should be under the responsability of the final user, but would be subsidized if the distance exceeded a certain limit and/or the storage reservoir exceeded a certain size.

2. Biochemical treatment of the waste and land spreading of the resultant sludge in order that the final effluent be suitable for disposal in waterways. This again would have to be subsidized because of its high cost. It should be done at the individual farm level rather than at a community treatment plant.

3. Switch to solid manure handling. Because of the high labour requirements, this may be impossible to implement. Another constraint of this method of handling manure may be the intrinsic design of the building.

The Pesticide Controversy

by Professor W. Marshall
Department of Agricultural Chemistry and Physics

It is a good thing that the continued use of pesticides is being questioned. However, the many sensationalized reports of the agricultural use of these chemicals have led to a general polarization of public opinion, which seems extreme to me. One point of view is typified by a poster of third-world children in a state of advanced malnutrition. Appropriately, the photo is in black and white and the caption is elegant in its simplicity — "Pesticides are for food". This extreme is opposed by the famous photograph taken on one of the Apollo missions to the moon. A small, fragile, blue ball, shrouded in swirling white clouds, is suspended in the vastness of space. It is popular to talk of our spaceship earth as being somehow out of control and we find ourselves without an operator's manual. The connotations are obvious and, for many, the use of any pesticide is tantamount to poisoning our habitat and ourselves with it. In such a highly controversial technology, it becomes difficult to separate the advocacy from the experimental observation, the conclusions from the facts and, above all, to cut through the rhetoric.

In its broadest sense, a pesticide might be best described as any compound, organism, or system that is applied by man to reduce the deleterious impact of other organisms on his total welfare. Intuitively, this interpretation seems

'e too broad. In common usage, e term pesticide usually refers to synthetic organic chemical which ssesses selective biological activi- toward a crop pest — noxious eds, insects, or microorganisms ually fungi). It is worth repeating it pesticides are highly selective; ey are not biocides. Nonetheless, nong the many chemicals with ich man contaminates his en- onment, pesticides are almost ique in that they are deliberately ded to control another form of .

e rationale for the continued use these chemical control agents is reduce or mitigate crop losses or mages to economically accept- le levels. The eradication of a op pest is not the objective, nor ould it ever be. Rather, a risk- nefit analysis must demonstrate at the benefits in terms of creased quality and productivity ust significantly outweigh the risks human health, the environment, d the economy. The costs of sticides are spiralling and the ssible deleterious effects on our vironment require a studied and dicious use of these chemical isons, if they are to be used at all.

ow Poisonous is Poisonous?

nlike hazard, risk, or safety, which e dependent on usage patterns, xicity is inherent to the chemical. esticides are a series of otherwise related chemical compounds hich are grouped together simply ecause they are used for the same neral purpose. The physical and emical properties of these com- unds vary greatly from one to nother. It is not surprising, then, at their toxicity to non-target ganisms (including man) also ries greatly. Toxicity is defined mply as the capacity to produce jury. Hazard is best considered as e probability that an injury will sult from the use of a substance a proposed quantity and manner. ne can use toxicological data to rive at some sort of hazard as- essment.

though it may be crude, the most ommon toxicological criterion of in- ry produced by acute exposure is eath and the most frequently cited atistic for comparing toxicities is e LD_{50}. This index is a statistical estimate of the dosage (in milli- grams of toxicant per kilogram of body weight) required to kill 50 per cent of a test population. Estimates of the LD_{50} for each chemical will vary with each test organism and with the route by which the test organism contacts the chemical. There are other scales or measures of toxicity and certainly chemicals will be injurious to an organism at dosages well below lethal levels. Even though the LD_{50} is not a valid index of overall toxicity, the accom- panying table may hold a few sur- prises. A low LD_{50} means a highly toxic compound and, as you will notice, some of those listed are no longer in wide use.

Environmental Fate of Pesticides

Since pesticides bear little chemical relationship to one another, it is not surprising that their environmental fates are also quite different. Once applied at a specific site, several dif- ferent processes begin acting on the pesticide. It may be physically transported away from the site of application by wind, rain, or runoff. Quite apart from physical transport, a variety of chemical processes begin to transform or degrade the pesticide. Air oxidation, sunlight, and components in natural water and soils convert the parent compound into a multiplicity of transformation products. In addition, the action of microorganisms will add to the rate at which the toxicant is converted eventually to innocuous products. An index of the persistence of a pesticide at the site of application is the "half-life" for that compound. It is simply the time required for the amount of initially applied compound to be reduced by half. The half-life of any given pesticidal compound is a function of both its chemical nature and the environmental condi- tions to which it has been exposed. Because environmental conditions vary from place to place, this term should only be used if strictly qualified by the environmental condi- tions.

Legislative Control of Pesticides

The complexities of the effects of using any chemical control agent re- quire that a thorough series of scientific studies be conducted on any new candidate pesticide. The sale, transport, and distribution of these chemicals are controlled by law (Pest Control Products Act). Prior to registration, Agriculture Canada requires a thorough study of the product's chemistry, of its metabolism and toxicology, of its en- vironmental fate, and of its efficacy and levels of residues on agricultural produce. These studies are time-consuming and very expen- sive. It has been estimated that the development of a new candidate pesticide requires at least four to five years and approximately $15 million. Assessing hazards based on these studies and other supporting data represents a complex and soul- searching attempt to be reasonably certain that no undue risks are associated with the proposed use of a pesticide. Thus each control agent

Table 1. **Estimated oral LD_{50} values to the rat of some pesticides and common household products.**[1]

Compound	Estimated LD_{50} (mg/kg)	Compound	Estimated LD_{50} (mg/kg)
DDT	200	Benomyl	10,000
Chlordane	400	2, 4-D	550
Endosulfan	75	Atrazine	3,000
Parathion	10	Table Salt	4,000
Malathion	2,000	Sugar	27,000
Carbaryl	500	Baking Soda	3,500
Captan	9,000	Aspirin	1,500
Carbofuran	10	Nicotine	50
Maneb	6,500	Caffeine	200

[1]Agronews, January 1981

is registered for a specific series of usage patterns. The terms "reasonably" and "undue" are subjective and, in essence, hazard assessment is a value judgement.

The processes of scrutiny and review do not end with registration. Registration may be reviewed and temporarily suspended or revoked if any new evidence becomes available. Ample evidence that the process is a continuing one is provided by the current status of the chlorinated phenoxy herbicides (2, 4-D and 2, 4, 5-T) in Canada. These herbicides have been in general use since the late 1940s and are probably the most widely used of the currently available herbicides. Despite the many safeguards built into the Canadian system of registration and the extensive scientific support of research establishments in government, industry, and university, the ultimate responsibility for the safe handling and use of pesticides must ultimately rest with you and me, the users.

Hazards Associated with the Use of Pesticides

Hazards associated with the use of a pesticide can conveniently be classified into those risks incurred during application and those risks due to residues of the control agent. The degree of hazard to the spray applicator will vary considerably according to the pesticide being used and the method of application. Certain pesticides while not persistent in the environment are relatively toxic to humans (some of the organophosphorous insecticides, like parathion, are a good case in point). Moreover, they may be ingested by a variety of mechanisms: absorption through exposed skin, inhalation of vapours or aerosol. When using these compounds, full protective clothing and a mask designed to filter out the insecticide are a must if the applicator is to be protected adequately. Many other insecticides and most of the herbicides and fungicides are not nearly as toxic and such stringent procedures are not necessary. Nonetheless, a series of sensible safety procedures and precautions are only common sense. One should avoid breathing the vapours or any skin contact with the spray. Any exposed areas of skin should be washed before smoking or eating. Frequent changes of clothing are suggested. Above all, should an accidental exposure occur, have an idea of the recommended remedial procedures as printed on the label.

Hazards to other non-target organisms (the environment) are much more difficult to assess or control. To obtain an even spray coverage, the pesticide is almost always applied as an aerosol of a liquid suspension/solution or as a dust. Significant quantities of these materials may drift to non-target areas, carried mainly by winds. This may be more critical in the case of certain herbicides, most notably the phenoxy herbicides (2, 4-D) whose action is to mimic natural plant hormones. Susceptible plant species which may be down-wind of the spray target area are particularly at risk.

Use or misuse of herbicides around wells or other sources of water may result in point source contamination. Distinct modes of entry, may result from spills of concentrate, spills or back-siphoning of diluted spray solutions, drifts or storm runoff from adjacent treated areas, or even subterranean movement into wells from spills or normal runoff. As a result of such entries, contaminations have been observed with such relatively persistent pesticides as amitrole, dinoseb, and picloram. Following a spill with dinoseb in Ontario, well-water was "decontaminated" by continuous pumping. However, during the subsequent spring thaw and runnoff, dinoseb re-entered the well.

A somewhat more insidious source of contamination may result from the disposal of unwanted spray concentrate, diluted spray or even of the pesticide containers themselves. It has been estimated that unrinsed containers may contain between 0.05 to 5 per cent of the formulation (as much as 325 g in a gallon container). Triple rinsing with water will remove more than 90 per cent of this residue, and the rinses can in turn be added to the diluted spray. Although the efficiency of the procedure will vary depending on the water solubility of the pesticide, it certainly cannot hurt to thoroughly rinse the containers and add the rinses to the spray.

During the pest spraying period, worker re-entry into a treated area represents a risk which will vary with the persistence of the pestic[ide] and the elapsed time from the la[st] spray. Superimposed on these ar[e] climatic effects. As might be expected, much of the work on defin[ing] safe re-entry intervals has be[en] conducted in southern California [on] crops with dense foliage where th[e] problem is considered to be most acute. In the Canadian context, fo[r] the vast majority of control agents workers may re-enter a treated a[rea] with relatively little risk as soon as the foliage has dried. In a few cases, a 24-hour interval (methom[yl,] mevinphos) or a 48-hour interval (azinphosmethyl, parathion, carbofuran, or demeton) is recomme[nd]ed prior to re-entry for extended periods of weeding or thinning. In [some] usage patterns, a mimimum numb[er] of days past spray are required by law prior to harvesting any produc[e].

Although certain members of our second and third generation pesticides may be somewhat more toxic to humans (certain organophosphorous and carbamate insecticides), they are very much less persistent than the relatively recalcitrant first generation compounds. The use of organo-chlorin[e] compounds, which were quite sele[c]tive, highly efficacious and of low mammalian toxicity, has been severely restricted in recent years because they tended to persist in the environment. As a result of these restrictions, pesticide residu[es] on agricultural produce and in othe[r] environmental samples have continued to decrease in recent years.

Certain animal species tend to be particularly susceptible to pesticides. These include honey bees, other beneficial pollinators, and certain species of fish. A continued environmental monitoring p[ro]gram is a must to ensure that aquatic and terrestrial ecosystems are affected as little as possible.

In closing, it seems worthwhile to reflect on the future of chemical control agents. Many other techniques seem to offer attractive alt[er]natives. Nobody would question th[e] concept of an integrated pest management approach which wou[ld] include the use of resistant plant varieties, the practice of crop rota-

(Continued on Page

The Family Farm

Published in the interests of the farmers of the province by the Quebec Department of Agriculture.

DUSTRIAL CROPS COMMITTEE OF CPVQ: NEW CORN ECOMMENDATIONS IN 1981

e Industrial Crops Committee has epared a new list of recom-ended hybrids in 1981. This list, sed on the results of trials carried out from 1978 to 1980, replaces that which was published previously and which was based on trials from 1977 to 1979. These new recommendations have been made possible through the more rapid processing of the data.

RN HYBRIDS FOR FORAGE PRODUCTION.

brids	Zone of 2500 C.H.U. and Higher			Zone of less than 2500 C.H.U.		
	Moisture Content at Harvest %	Yield (Dry Matter) %	Contribution of the cob %	Moisture Content at Harvest %	Yield (Dry Matter) %	Contribution of the Cob %
92 (Pioneer)	—	—	—	66,9	13 760	50,2
rwick W777	—	—	—	67,3	16 409	48,6
106 (Asgrow)	63,6	12 751	56,8	68,1	12 514	55,7
rwick W844	64,0	14 933	49,3	70,4	15 375	44,5
ponté 3S	64,7	13 820	62,4	68,0	15 282	48,7
22 (Asgrow)	64,8	11 170	58,6	66,1	12 420	51,3
nk G4065	65,3	13 729	58,9	67,4	15 340	48,7
rgill 810	65,4	14 874	55,0	—	—	—
kseed 2277	65,9	13 985	59,7	70,2	14 744	45,2
de 1128	66,0	15 389	53,9	68,5	16 968	44,3
nk G4082	66,1	13 142	58,8	68,4	14 564	48,1
75A (Pioneer)	66,6	14 435	56,6	—	—	—
rwick TX20	66,6	13 973	45,9	71,2	15 104	45,7
-G SX111	66,7	13 978	57,4	67,5	14 591	50,6
wart 3701	67,1	14 581	51,8	71,0	13 953	42,6
311 (Dekalb)	67,3	14 447	52,7	67,4	15 452	42,8
35 (Pioneer)	67,3	14 410	55,8	67,3	17 613	48,2
jan T833	67,5	14 256	56,7	69,9	16 603	43,9
wart 255	67,6	12 934	56,4	68,4	15 316	46,9
42 (Asgrow)	67,9	15 711	54,4	—	—	—
12 (Dekalb)	68,3	16 306	51,6	—	—	—
de 2206	68,4	15 240	55,5	69,6	15 832	41,7
36 (Asgrow)	68,7	15 028	54,5	—	—	—
wart 38	68,7	14 407	51,5	70,3	16 258	42,1
op S260	68,8	12 679	58,5	67,6	14 570	50,0
29 (Asgrow)	69,2	13 481	57,3	70,1	14 588	44,5
nk G4040	69,3	14 159	49,7	71,7	15 977	47,1
op 277	69,3	14 130	54,8	69,2	14 959	48,4
7 (N.K.)	69,3	13 447	52,8	65,8	15 992	50,8
eco U 322	69,4	15 130	46,7	—	—	—
eco UC 1133	69,4	13 817	57,6	70,5	14 358	45,0
295 (Asgrow)	69,8	14 811	52,6	70,1	16 840	45,8
nk G5191	69,8	13 732	52,7	70,8	16 226	42,7
eco UC 1905	69,9	16 486	46,8	72,9	14 906	35,4
op M279	69,9	15 037	53,4	—	—	—
rwick TX27	69,9	14 579	52,4	—	—	—
rdinal SX85A	70,6	15 166	58,3	69,2	15 216	47,1
16 (Dekalb)	70,8	17 108	45,5	—	—	—
de R108	71,0	12 631	54,3	69,0	14 759	49,9

CORN HYBRIDS FOR GRAIN PRODUCTION

Corn Heat Units	Hybrids	Moisture Content at Harvest %	Average Yield kg/ha 15% moisture	Broken Stalks %
2600	Warwick SL207	28,2	7 375	9,2
	UH 106 (Asgrow)	28,4	7 024	21,1
	Stewart 2501	28,5	7 328	13,7
	Co-op S259	28,6	7 638	12,3
	Warwick W777	29,1	7 790	12,7
	3952 (Pioneer)	29,1	7 777	3,9
	Trojan T778	29,5	7 685	19,6
	Hyland HL2219	29,5	7 552	18,1
	Oseco UC 1104	29,6	7 226	13,2
	Stewart 255	29,8	7 282	10,6
	Labonté 3S	30,0	7 805	14,6
	Cardinal SX85A	30,0	7 784	13,4
	Stewart 278	30,0	7 045	9,5
	P-A-G SX111	30,1	7 541	7,6
	Pickseed 2277	30,3	8 034	11,9
	Cardinal SX2222	30,5	8 378	14,7
	P-A-G 503	30,6	6 908	6,6
2700	Stewart 2660	30,8	7 827	16,3
	3977 (Pioneer)	30,9	6 743	4,2
	Hyland HL2216	31,0	7 859	10,8
	Cardinal SX85	31,0	7 499	14,5
	Pride R108	31,1	7 759	10,2
	3975A (Pioneer)	31,1	7 438	2,8
	Stewart 38	31,3	7 156	9,3
	PX 414 (N.K.)	31,4	7 926	10,0
	Oseco UC 1106	31,4	7 696	9,2
	3978 (Pioneer)	31,6	8 004	8,5
	Pickseed 2262	31,6	7 162	10,9
	Trojan T801	31,7	8 291	6,7
	RX 29 (Asgrow)	31,7	7 049	7,2
	Funk G5048	31,7	7 013	7,6
	PX 11 (N.K.)	31,8	8 113	5,3
	Pride 1128	31,9	7 657	7,1
	Cargill 810	31,9	7 076	8,1
	Funk G4082	32,1	7 534	11,5
	Co-op S260	32,1	6 686	13,3
	5650 (Pioneer)	32,4	7 708	3,0
	Co-op S265	32,4	7 621	12,9
	PX 419 (N.K.)	32,5	7 678	7,7
	PX 7 (N.K.)	32,7	7 402	9,8
	Stewart 3701	32,9	7 056	9,4
	RX 30 (Asgrow)	33,7	6 079	9,6

CONSEIL DES PRODUCTIONS VÉGÉTALES DU QUÉBEC

CEREAL CULTIVARS RECOMMENDED IN 1981

OATS

Cultivars	Origin	Year of licensing	Yield (54 trials) average 78-80 (kg/ha)	relative (A)	% Hulls	Straw cm	Lodging (1-9) (B)	Earliness (days)	Weight per 1 000 seeds (g)	Weight per hectolitre (kg)	Availability of Pedigreed Seed in Canada (ha)
Lamar	Québec	1979	3966	109	27.5	98	3.3	99	28.3	43.7	not available
Manic	Québec	1979	3728	103	26.0	97	3.1	98	32.3	45.5	29
Laurent	Québec	1977	3884	107	26.8	107	3.4	96	29.0	46.5	private cultivar
Oxford	Ontario	1976	3650	101	25.7	99	2.5	99	29.6	44.0	private cultivar
Alma	Québec	1974	3629	100	27.4	93	3.4	96	30.0	42.1	332
Scott	Ontario	1974	3539	98	25.5	105	3.4	97	31.8	45.0	2678
Yamaska (C)	Québec	1968	3389	93	23.5	101	3.3	95	28.8	44.7	none
Dorval	Québec	1964	3523	97	24.2	107	3.6	98	30.1	45.6	56
Garry (D)	Manitoba	1953	3351	92	27.7	106	3.6	97	28.7	44.2	4300

(A) The average of the 1978-80 trials = 100.
(B) Scale from 1 to 9. 1 = resistant, 9 = very susceptible.
(C) Yamaska will not be recommended after 1983.
(D) Garry will not be recommended after 1982.
(E) R = resistant; MS = moderately susceptible; S = susceptible; VS = very susceptible; Mt = moderately tolerant.
(F) Behaviour of cultivars during heavy and early infections of BYDV early in the season. The behaviour may be slightly different during late infections.

REACTIONS TO THE MAIN DISEASES (E)

Cultivars	Loose and covered smut	Speckled leaf blotch	Yellow dwarf (F)	Leaf rust
Lamar	S	MS	MS	MS
Manic	S	S	MT	VS
Laurent	S	S	S	S
Oxford	?	MS	MS	S
Alma	R	S	S	MS
Scott	R	S	S	S
Yamaska	R	VS	S	S
Dorval	S	S	VS	S
Garry	R	S	VS	S

·RING WHEAT

ıltivars	Origin	Year of licensing	Yield (56 trials) average 78-80 kg/ha	relative (A)	Straw (cm)	Lodging (1-9) (B)	Earliness (days)	Weight per 1,000 seed (g)	Weight per hectolitre (kg)	Availability of pedigreed seed in Canada (ha)
ısavent	Québec	1980	3477	106	96	2.2	106	39.0	73.4	not available
ndas	PEI	1979	3322	101	87	1.8	101	35.8	73.9	60
·al 19	Québec	1979	3425	104	76	ı.6	105	34.3	72.2	private cultivar
al	German	(D)	3461	106	92	2.1	103	33.2	73.3	propagated in the maritimes
ncorde	Québec	(E)	3234	99	77	2.3	105	34.9	74.6	1395
‹ra	Holland	(E)	3433	105	92	2.1	104	33.6	74.0	private cultivar
ton	Saskatchewan	1975	2993	91	93	1.8	101	33.6	75.3	8892
·nlea	Manitoba	1972	3155	96	95	2.3	101	40.8	74.8	4350
·epawa (C)	Manitoba	1969	2916	89	90	1.8	99	31.0	74.7	56818

The average of the 1978-80 trials = 100.
Scale of 1 to 9.1 = resistant;
9 = very susceptible.
Neepawa will not be recommended after 1983.
Sale authorized in Quebec and the Maritimes only.
Sale authorized in Quebec.
R = resistant; MR = moderately resistant;
MS = moderately susceptible; S = susceptible;
VS = very susceptible.

REACTIONS TO THE MAIN DISEASES (F)

Cultivars	Speckled leaf blotch	Powdery mildew	Loose smut	Root rot and head blight	Ergot	Leaf rust
Casavent	MS	MR	S	S	—	R
Dundas	S	S	S	S	—	S
Laval 19	MS	MR	S	S	S	R
Opal	S	MS	S	S	S	S
Concorde	MS	S	MR	S	MS	R
Ankra	S	MS	R	S	S	S
Sinton	S	MS	R	MS	S	R
Glenlea	S	MR	R	S	VS	R
Neepawa	S	VS	R	MS	S	S

·RLEY

ıltivars	Origin	Year of licensing	Yield (56 trials) average 78-80 kg/ha	relative (A)	Straw (cm)	Lodging (1-9) (B)	Earliness (days)	Weight per 1,000 seed (g)	Weight per hectolitre (kg)	Availability of pedigreed seed in Canada (ha)
·dford	Manitoba	1978	4010	104	81	2.2	92	35.0	61.9	2697
ıce	Ontario	1977	4072	105	80	2.4	89	34.6	62.7	Private Cultivar
ırier	Québec	1975	4152	107	85	3.0	91	43.4	59.9	Private Cultivar
·yola	Québec	1972	3999	103	88	2.8	91	39.9	61.2	Private Cultivar
ınanza	Manitoba	1970	3808	98	91	2.7	91	35.2	59.8	24541
·nquest (C)	Manitoba	1965	3608	93	93	2.3	90	35.7	58.9	3596

The average of the 1978-80 trials = 100.
Scale of 1 to 9.1 = resistant, 9 = very susceptible.
Conquest will not be recommended after 1982.
R = resistant; MR = moderately resistant;
MS = moderately susceptible; S = susceptible;
VS = very susceptible.

REACTIONS TO THE MAIN DISEASES (D)

Cultivars	Loose smut	Leaf blotch	Powdery mildew	Net blotch
Bedford	R	S	S	MS
Bruce	R	S	MS	R
Laurier	R	S	VS	VS
Loyola	S	S	MR	VS
Bonanza	R	S	S	MR
Conquest	R	S	S	R

ntinued from page 14)

ı and procedures whereby the tural control agents are given the timum conditions to be effective. ;o included would be biological ntrol measures. However, many the environmental effects of sticides will also be present when ological control agents are aped. It seems inevitable that in the ure we will have to rely on emical control measures in the ıny situations where no viable ernative exists.

The present, and in my opinion very necessary, plethora of tests which are required for registration place a heavy financial burden on the chemical manufacturers. A very large market (multinational in scope) is required to recoup the initial development costs of new pesticides. Target species rapidly develop a resistance to these chemical control agents. Thus, a relatively short lifetime (in terms of efficacy) can be predicted for any new candidate pesticide. What is more insidious is that the rate of developing "race resistance" appears to be accelerating. Therefore, there is even less incentive to develop the new candidate pesticides which will be required in the future. We shall have to continue to finance those studies required for a particular minor-use pattern. Minor-uses are those uses of a pesticide for which the anticipated sales volume is not sufficient to persuade the manufacturers to carry out the necessary research required for registration. Above all, we shall have to be ready to modify existing practices to take advantage of new developments.

This Month with the QWI

Information from FWIC

One of our purposes as a national organization is "to develop better informed, more responsible citizens through the study of issues of National and International importance". With this thought in mind, the FWIC has suggested the following list of material on Canadian Unity which could make for thoughtful study and discussion at branch meetings.

1. Statement on National Unity made by Federated Women's Institutes of Canada (1977 Board Minutes p. 7).
2. Unity of a People — by John Robarts.
   The Editor — **Spectrum,**
   Canadian Imperial Bank of Commerce,
   Head Office, Commerce Court,
   Toronto. Ontario M5L 1A2
3. British North America Acts (price $1.75 per copy)
   Editing Centre, Government of Canada,
   Department of Supply & Services,
   Reference Services,
   Ottawa K1A 0S9
4. The Canadian Constitution 1980 (proposed Resolution)
5. Explanation of above Resolution
   Publications Canada,
   Box 1986, Station "B",
   Ottawa K1P 6G6
6. Women and Constitutional Renewal by Mary Eberts
7. Summary Notes on above
8. Women, Human Rights and the Constitution by Beverley Baines
   Items 6. 7 and 8 are all obtainable from
   Canadian Advisory Council on the Status of Women
   Box 1541, Station "B",
   Ottawa K1P 5R5
9. The Power Split (from MEMO)
   National Action Committee on the Status of Women
   Copies from the National Office,
   28-46 Elgin Street,
   Ottawa K1P 5K6

N.B. Except where indicated there is no charge for any of this material.

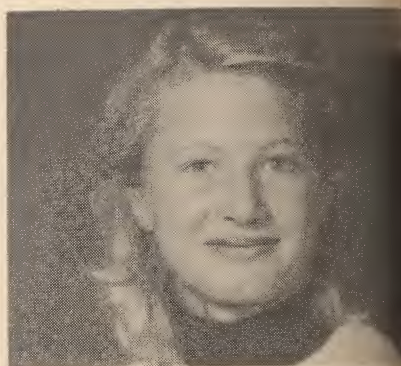
Subscribe to Federated News!

Federated News is the quarterly publication of FWIC. It is a compact little magazine with a cheerful colour border and an interesting picture on the cover. Inside, programs and projects of the WI in all provinces are reported as well as articles about special interests and concerns — Agriculture, Health, Safety, Energy Conservation, Women in the Third World. Many of these articles make a splendid basis for a program discussion and all program materials for loan are listed on the back page. For all this you pay only $1.50 each calendar year and Federated News will be delivered to your door. You may subscribe any time, back issues will be sent to you and your name added to the mailing lists. Renewals are due in December. Please decide to subscribe and send your cheque or postal order with your name, address, postal code to: Federated Women's Institutes of Canada, 28-46 Elgin Street, Ottawa, Ontario K1P 5K6.

Standstead Scholarships

The **Stanstead County** Women's Institutes offer three scholarships each year. The "Estella Holmes" which is given to a student of the County continuing his or her education after high school graduation. This scholarship is financed by the five County branches each contributing $20. The scholarship was established several years ago as a memorial to the late Mrs. Estella Holmes, who started the County Institute and served as the first President. At the time she was a member of the Ways Mills branch. In later years her daughter, Norma Holmes was WI Secretary at Macdonald.

When the scholarship was started was awarded to a student taking teacher's training at Macdonald. changes have occurred so has the policy of the scholarship, and now goes to anyone in the County seeking a higher level of education. This year the scholarship was awarded



to Karen Hornby, daughter of Mr. and Mrs. Richard Hornby of Georgeville. She is a graduate of Alexander Galt Regional High School and is now enrolled at Champlian College studying thera... She plans to enter the University of Western Ontario as a student of physiotherapy.

The "Maud Lillian Kezar" scholarship was established under the will of the late Miss Kezar, who was a member of North Hatley WI and w... always interested in home economics. According to the regulations of the will, the scholarship is go to a girl taking a full course in Home Economics with the intention of making her profession in this field. The requirements are rather stiff and, as few apply for it, the interest on the principal adds each year. This year the application of Colette Boucher from Sherbrooke was approved and the amount was $500. She is a graduate of Alexander Galt Regional High School and is now studying at Acadia

versity in Nova Scotia. She has privilege of renewing each year oughout her course.

"Dr. C.L. Brown Memorial" olarship was established after death of this beloved country ctor and each year the interest es into a $100 scholarship. This is rust to the WI Scholarship Comtee, as are the other two. It is arded to a boy or girl who is a ident of the Ayer's Cliff area paring to enter the medical prosion. This year it was awarded to

ene Keet, daughter of Mr. and s. Stanley Keet of Brown's Hill, ween Ayer's Cliff and Fitch Bay. ene is a graduate of Alexander lt Regional High School and is olled as a nursing student at the ebrooke CEGEP.

Hatch
nstead County Publicity
nvener

y Sight-Seeing

most of us, a day in the city ans a trip to go shopping, visit nds, or keep a medical appointnt, but for a busload of 45 men from the **Dewittville** WI and ir friends, September 10 meant a of sigh-seeing in Montreal.

first stop was St. Joseph's atory. Here they were joined by s. Rosalyn Tetley who was the guide for the rest of the day. mbers visited the Oratory at its erent levels and learned that in te of its immense size, it is so nstructed that it is always warm

The members of Valcartier WI visited the Montreal Floralie, the International Flower Exhibit.

and comfortable and has accommodated up to 16,000 people at a Christmas service. As it was a beautiful clear day, from the upper level visitors could "see forever", across the city and off to the Laurentians. After the Oratory, the tour passed Beaver Lake, across Mount Royal Park, then east on Pine and Cherrier to observe the Victorian architecture. One of Montreal's striking characteristics in the St. Denis-Cherrier area is the variety of ornate outdoor stairways, winding, twisting, and undoubtedly slippery in winter. After passing Lafontaine Park, the Botanical Gardens, and the Olympic Stadium, the group continued down to old Montreal and the waterfront, dropping in at the old du Calvet House, built before 1725 and acquired and restored by Ogilvy's Department Store in 1966. At present an exhibition of early Quebec furniture is being presented by the Montreal Museum of Fine Arts. Across the street is the old Bonsecours Church, often referred to as the "Sailors Church" as in years gone by many a lonely sailor found rest and peace in this haven by the harbour.

Ile Ste. Helene was the next port of call, where plans had been made to dine at the Au Festin du Gouverneur in the old fort. The waiter and waitress were dressed in 18th century garb, and the furnishings and tableware were all period pieces. Soup was "supped" straight from the bowl, and food was eaten with fingers as knives were the only flatware utensils used in the early days. Longueuil is one of the oldest towns in Canada and some of the original homes are being preserved and recommended for viewing on tours. These are heavy old stone structures of various sizes, and the group stopped to view the exterior of some of the houses on St. Charles Street. While in Longueuil members also visited le Musée Historique de l'Électricité on Chambly Road. This Museum opened in 1954 and contains electrical appliances and objects collected over a period of 50 years by Gaston La Badie, a master electrician. While on the South Shore, the group also visited le Musée Marsil on Riverside Drive in St. Lambert. This is a renovated 18th century farmhouse which, at present, houses a collection of art objects of the Woodland Indian on loan from the McMichael collection at Kleinburg, Ontario. Paintings, porcupine quill baskets, and a tamarack bird were among the items on display.

The bus continued along Riverside Drive and along some of St. Lambert's older streets such as Green and Victoria, thence to Tachereau Blvd. and home. The weary passengers had many things to think about concerning our past and present.

A Great Christmas Meeting

The early Christmas meeting of the Howick WI was full to overflowing with a variety of different projects. Not only was there a wonderful Tupperware demonstration and a bring-and buy-food and craft sale to raise extra money for the Barrie Memorial Hospital Campaign, but there was also a delicious luncheon dessert which satisfied everyone's appetite. Mrs. Harold Robertson gave an excellent report on the Semi-Annual Board Meeting with much information on past, present, and future projects. This proved to be only the beginning as two more exciting events were to follow.

Two Life Memberships were presented: the first to Mrs. Leslie Wright, a truly remarkable lady. Born in Finland in July 5, 1896, she was educated in Finland, Canada, and the United States. She joined the WI in 1936 in Cowansville and has always contributed to the WI and to the community, particularly with her training and experience as a nurse. She nursed in Cowansville, Huntingdon, and at the Montreal General during the period 1936-62. She was awarded the Blue Cross in Finland for serving on the front lines in 1917-18 and a George VI medal, the only nurse in Canada to be so decorated. Mrs. Robert Tolhurst and Mrs. Bruce Cairncross presented her with her certificate and pin.

The second presentation was to Mrs. Haddon Kerr of Fertile Creek and Howick. Mrs. Kerr was educated in Ormstown, Howick, and at Macdonald College and taught school until the time of her marriage. She has held the offices of Convener of Publicity and of Education and has been a valued member, a regular attender, and a most willing participant in our programs, and knits continually for projects such as CanSave. She has also attended county and provincial conventions.

The demonstration for this meeting was in the capable hands of Leslie Bonnor, Convener of Home Economics. On a long table suitably decorated for Christmas, a breathtaking display of cakes and desserts from countries around the world showed us the great variety of ideas that abound in the traditions of different countries. Each item was suitably arranged in or on an attractive base and displayed the country's flag. Behind the table, a map of the world showed each country discussed in the demonstration.

Starting with Canada, we were shown the traditional dark fruit cake with almond topping and icing. Then a large shortbread in the shape of a thistle was Scotland's contribution. France's dessert was a Bouche Noël, a delicious-looking chocolate log. Nearby was Germany's Dresdner Stollen, a yeast-based fruit and nut loaf which appealed to everyone. A beautiful crystal dish held the sweet meats from Italy — Dolce — full of delicious candied fruit and nuts, minced and rolled

Life Membership pins went to Howick's Mrs. P. Kerr and Mrs. L. Wright. Below: Mrs. L. Bonner demonstrating Christmas cakes.

together. Czechoslovakia was represented by a Jabokovy Dort — a scrumptious hazel nut and chocolate cream cake with poached apples and chocolate cream topping. A wicker basket held the African Makrond, which was a mould made from crushed wheat or manioc with sweetened almonds and decorated with dates and apricots. Australia presented a Pavlova, a meringue based dessert, filled with fruit and cream. Lastly, a wooden boat held a display of Bizcochitas, anise cookies, from South America.

The following section was inadverently misplaced and did not appear in Mrs. von Brentani's February column. We print it now with apologies for the delay.

Belvidere's ladies chose as motto: "Being a good neighbour is being a good citizen." They donated money to the Lennoxville Library, to the Welfare Lunch Program of the Lennoxville Elementary School and to the Legion. **Brompton Road's** motto: "A man's feet should be planted in his country, but his eyes should survey the world." Welfare and Health Convener, Mrs. Betty Emery, reported that 825 cancer dressings were made and a generous sum was turned in for gifts for cancer patients. **Ascot** had as guest speaker Mrs. Wm. Pearson; she told of her daughter Anne's recent trip to Somalia, East Africa, Anne, who is Director of Education Program at the Ottawa Y, went on a fact-finding mission, along with four other representatives of international agencies, to view the refugee problems there. A severe drought has dried up water sources, causing crop failures, which calls for drastic help with food, medical supplies, and so on. **Milby's** donations were made to the Cancer Society and to the Lennoxville Elementary School lunch fund.

Lennoxville's motto: "The test of tact is not how often you please but how seldom you offend." The Home Economics Conveners gave hints on the use of salad oil and salt in a paste for removing heat stains from furniture and the use of cold tea for cleaning windows and mirrors. Welfare and Health Convener Mrs. F. Beattie, reported that 255 cancer dressings were made, and 15 pairs of eye glasses turned in. A most successful bazaar and chicken salad supper was held with a special sale of CanSave Christmas cards and a table for the Nutrition Education Save Sight Fund. Citizenship Convener, Mrs. D. Geddes had a contest "How well do you know your initials?" Initials of local, national, and international organizations were listed. Time: 10 minutes. The winners were Mrs. Warren Ro... and Mrs. Harold Worster, tied for first place. Mrs. Sterling Parker conduced the program on: Give the origin of six Christmas carols from various countries: Italy, Germany, Austria, Great Britain, Spain, and Canada. Each carol was sung in turn.

Hatley hosted an Open House to honour Mrs. Olive Bray who was observing her 90th birthday. Mrs. Aileen Lord, County President, presided at the beautifully appointed refreshment table. Mrs. Lord and Mrs. John Johnston, County Treasurer, presented Mrs. Bray with a box of fruit and other goodies and from the Hatley branch, the birthday lady received a bouquet of flowers and a sweater. Mrs. Bray has been very active in WI as a member of Hatley and as County Treasurer for many years.

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